

ECONOPHYSICS Section

AN ADVANCED MODEL FOR MIXED ECONOMY

Ion SPÂNULESCU*, Anca GHEORGHIU*

***Abstract.** In this paper the general principles and categories of mixed economy currently present in different countries of the world are presented. The paper also presents an Advanced Model of Mixed Economy with Threshold (AMMET) which is characterized by a reduced value (approx. 10-15%) of the State and public sector participation in the national economy and proposes and analyzes an econophysics model for the mixed economy. Finally, there are some suggestions and recommendations for the improvement and optimization of the Romanian mixed economy system.*

***Keywords:** mixed economy, government spending, econophysics model, advanced model of mixed economy with threshold (AMMET), two-speed retirement.*

1. Introduction

The mixed economy is present in almost all of market economy countries, without being expressly mentioned by this name. However, this economic model has a great diversity, depending on the degree of involvement of the State and the public sector in the economy of the world countries, therefore, in this paper a systematization of the various aspects of the mixed economy is being attempted, for countries where this economic model is used.

In the first sections of the paper are presented the principles of the investment economy from the general equation of the economic balance formulated by J. M. Keynes [3], as well as the concept of the mixed market economy formulated by the AP Samuelson within the equilibrium equation for mixed economy [4,7]. The following are mentioned the types of mixed economy, according to the degree of interference of the State in the economy and the size of the public sector within it. We also propose an advanced model of mixed economy with threshold (AMMET) and an econophysics model for the mixed economy and show the peculiarities and advantages of the new economic model, with reference to the case of the mixed economy in Romania [7].

* Hyperion University of Bucharest, 169 Calea Călărașilor, St., code 030615, Bucharest, Romania, e-mail: ion.spanulescu@gmail.com; anca.gheorghiu@gmail.com .

2. Economic balance equation for mixed economies

2.1. General Considerations

Throughout the history of economic development there have been developed several types of economic models applicable for the given period, which were especially related to the way of obtaining the goods and services necessary to satisfy the needs of individuals or of society as a whole. In the following we will refer prepsently to the model developed by J. M. Keynes (1883-1946), subsequently completed by P. A. Samuelson (1915-2009), regarding the acquisition of Y income on the basis of investments I in the production process at macroeconomic level [3,4].

In Keynes's model on obtaining income based on investments it is shown that the Y income given by the value of the obtained production is used for consumption C but, in the case of a more advanced economy, certain savings S can be obtained, i.e. [1-3]:

$$Y = C + S. \quad (1)$$

Since the population's savings are usually found in investments I , that is to say $S = I$, the equation (1) becomes:

$$Y = C + I \quad (2)$$

equation that relates to the whole of the researched phenomenon, i.e. the entire (national) income Y , the total consumption C of the population and the totality of investments I and including the State in the economy.

The balance shall be maintained if all the savings are invested, i.e. $S = I$, meaning the demand and the offer are balanced. In case of $S < I$ or $S > I$, there may be some distortion related to the reduction of investment and demand and implicitly the production (supply) leading to incomplete occupation of the working hand (unemployment) or, on the contrary, when $I > S$ to the investment hazard when investments can no longer be accomplished. In order to prevent such imbalance, J. M. Keynes proposes an extension of the State's functions so that, through appropriate legislation or regulations, it can intervene in regulating the specific mechanisms of the market economy [3].

In the general equation (1) or (2) established by Keynes [3] as well as in other equations related to the value of the total income, the term indicating public governmental or/and governmental expenditures G is not explicit, although they exist in any modern State with an important public sector and centralized management (Government, President, Parliament etc.).

2.2. The “Mixed Economy” Model

Criticism of the Keynes’s theory and model concerned, in particular, that objectively the markets in a “perfect” market economy do not self-regulate in a short enough time, so that to avoid disturbances in terms of the efficiency of integral using of the workforce available at a time.

In order to eliminate such malfunctions, J. M. Keynes supported the idea of State intervention in the economy, that State would play a role in the market, as well as promoting social protection policies and achieving economic objectives of national interest. To mention that, much before, Adam Smith himself (1723-1790) and then, in the twentieth century, J. M. Keynes (1883-1946) considered the idea of State involvement in economics which, apart from the role of legislating and regulating the market, must also deal with the education of poor people’s children (Adam Smith), social protection in general, as well as the construction of large industrial and energy infrastructure etc.

When the interference of the State in economics became too large began to appear quite complicated issues related to the enhancing bureaucracy in public administration and the huge volume of public spending (with money from the budget) which in turn led to the increase of contributions and taxes (for budget formation), excise duties of all kinds, as well as the emergence of an excessive taxation that led to fiscal burden mainly of the private firms and hence the braking of private sector production and implicitly to all kinds of crises that have frequently been repeated in different countries or economic-social sectors.

In this situation, when the amount of public and government expenditure, noted together through G , had high values, there was no longer any talk of a pure market economy, but a **mixed** market economy, in which, in addition to the private sector, a second partner should also be considered, represented by the **State** and its **public sector**.

From the above, it follows that the **mixed economy** is essentially the system of the market economy in which, in addition to private agents and firms governed by free market laws, the State also participates, with the role of coordination, legislative control and participation in the economic process through the public (State’s) sector.

It can be said that the mixed economy has emerged with the first elements of the exchange (market) economy in State or tribal formations where there is a **single** or **collective leadership** that coordinates or controls any kind of human activity (hence the economy) within the society concerned.

Although the mixed economy's embryos existed for a long time, this form of economy developed especially after World War II, when for reconstruction of national economies, the State, according to the ideas of J. M. Keynes, began to be more involved in the economic regulations of the market economy countries, and in international economic relations, and as far as the socialist countries are concerned, the state has been totally involved leading "from the centre" – based on general planning – all economic and social-political sectors of the nation. The superiority of free market economies and anti-communist revolutions (bloody as in Romania, or velvet from other socialist countries) from the end of the twentieth century led to the bankruptcy of the centralist or command economy, from almost all of the former socialist countries with the exception of North Korea, Cuba and part of China, with the latter forming a specific type of mixed economy [7].

2.3. Macroeconomic equilibrium equation for Mixed Economies

Nobel Prize laureate in Economics for the year 1970, Paul A. Samuelson considers, except for the three aforementioned communist countries that in most countries of the world operates a mixed economy, with varying degrees of involvement and participation of the State in the economy.

In the conception of Paul A. Samuelson [4,5], in the mixed economy the regulation of economic proportions and the realization of the economic balance of economic growth are achieved through the simultaneous action of some methods and instruments of the free market (free market economy) as are demand and offer, prices, private investments, profits, loans, etc., and some methods and instruments directed by the State authority such as different categories of taxes, labor legislation, public orders and investments, public and government expenditure, economic legislation etc. [2, 3, 5]. Through its levers and institutions, the State can intervene in maintaining market balance by limiting or removing factors that may lead to deregulation and braking of economic growth. Like J. M. Keynes, P. A. Samuelson believes that the State must promote economic growth and economic efficiency, ensure social equity and well-being, hinder the development of unemployment and intervene for the payment of pensions and social benefits, to take fiscal and monetary measures to limit inflation and maintain economic balance, [4,5] etc.

When the State organizes its own enterprises or participates to investments at national level, then the governmental and public expenditure generally, noted together by G (from Government) acquires a significant

weight to be considered in the economic balance equation for the mixed economy model. As such, P. A. Samuelson introduced in the equation of the economic equilibrium for investments leading to an income Y , the term on state and public sector expenditure, named by him government expenditure, G . Because these expenses are extracted from total income Y , the term G enters the second member of the equation (1) or (2), resulting the following form for the general equation of economic balance in the case of the mixed economy where the State intervenes:

$$V = C + I + G. \quad (3)$$

The term G , introduced by Samuelson in the macroeconomic equilibrium equation [3], includes in addition to public and governmental spending (Government, Parliament, Presidential Administration and other institutions, agencies, organizations etc.) and the term I represents national investments (including the net surplus of the foreign trade balance, see [4, p. 409]).

From the equation (3) it follows that the high value of public and government expenditure, noted together by the term G , strongly affects the efficiency of the investment process at a given Y income, resulting in either diminishing consumption or investment or their simultaneous decrease in different proportions, depending on the given economic conditions.

Thus, from the analysis of the balance equation (3) for the mixed economy, it is obvious that in order to ensure optimum values for investment and consumption, the amount of non-productive expenditure G should be as low as possible, i.e. to establish a **limited threshold** of interference of the State in the economy, which must be as small as possible, and a minimum value of the public sector in the national economy.

Equation (3) where the second member shall take into account the presence of the State in the economy by adding the term G , indicating the Government's public expenditure of the State, bearing the name of the **economic equilibrium equation** in the case of **Mixed Economy** where the main players are the operators and the principles of the market economy on the one hand, and the State and the public sector, which takes part in a lower or higher grade in the economic system, on the other hand. It can be said that as long as there is and has been the role of State management and control of the human activities, we always had and we have to deal with a mixed economy, with the exception of centralized Socialist-type or centralized economies, where there are virtually no market economy but only centralized economy run and controlled by the State.

3. Development of mixed economies in different countries of the world

The State represents authority in a country through being the social and political factor that is required in society and can coordinate and control it in its interest.

We can say that the mixed economy has emerged with the market economy or with the market itself in a society or community led by a clan or tribal chief (at the beginning of the development of economic communities) or, further, by a central authority that is also the State. When most of the States were formed, and their economies developed heavily, especially after the industrialization era, there were several doctrines, currents, or schools that promoted or supported different economic theories, the majority being contradictory and tainted by political opinions or specific economic interests, etc. In terms of the mixed economy, the State's involvement in the economy can be mentioned here the existence of two currents that have developed since the second half of the 19th century, namely the Austrian School and the German School respectively.

The Austrian School emerged after 1870 and represented by Carl Menger, Friedrich von Wieser, Ingrid von Mises and others supported the noninterference of the State in economy, while the German School or Rhine Model represented by Gustav von Schmoller, Werner Sombart and their disciples expresses the exact opposite views by giving an important role to the intervention of the State in the market economy.

As already mentioned, Adam Smith himself and then, in the twentieth century, J. M. Keynes also took into consideration the idea of the State's involvement in the economy which, apart from the role of legislating and regulating the market, has to deal with the education of poor children (Adam Smith), social protection in general, as well as the construction of large industrial and energy infrastructure etc.

It is worth noting that all these disputes over the role of the State in economy were related to a mixed economy – which did not yet bear such a name – as they referred to the participation in the economy of both the elements of the market economy and the elements of centralized type that the central authority usually promotes, i.e. the State.

As stated in the preceding section, P. A. Samuelson perfected the model of the mixed economy, taking into account, explicitly, public (and/or governmental) spending G which cannot be neglected, especially when their value is high. In this way P. A. Samuelson established the general equation (3) of the economic balance for the mixed economy model. On the other hand, just

like J. M. Keynes, who also supported the idea of state involvement in economics, P. A. Samuelson made no mention of the degree of involvement or intervention of the State in the economy, although for a full substantiation of the mixed economy model, specifying the percentage of State involvement in the economy is of particular importance as it will be shown below.

According to Michel Albert [6], depending on the degree of involvement of the State and public sector in the economy and the support and development of social protection policies, we can distinguish between two major categories of models of the mixed market economies currently in place, namely [6]: The **Neo-American** or Anglo-Saxon model met in the U.S.A., England or Canada, and the **Rhine** model) represented by the economies of Germany, Switzerland, the Benelux and the Nordic countries (Sweden, Norway) [6]. The first model (Neo-American) is characterized by a minimum level of State intervention in the economy and a certain level of insurance of social protection measures, while the second model is characterized by a higher level (but not exaggerated, under 40%) of the public sector and a more significant intervention of the State in the socio-economic life of the country, as well as through a much higher degree of social protection (pension insurance, unemployment benefits, free education services and Health etc.) [6,7].

To point out, that even in the case of the Rhine Model the market has a dominant role, production and services are made especially in the private sector, and prices are adjusted on the basis of supply and demand under the laws of the free market.

As will be shown next, Japan and China have specific mixed economy systems for each country not being catalogued to enter the group of the two general models described above.

Depending on the philosophy underlying the socio-economic structures in the mixed market economy countries and the degree of State involvement in the economy, several types of mixed economies can be distinguished by groups of countries [7, 9,10]:

a) The **Neo-American** model in the United States of America. This model represents the most significant example of a mixed economy with a **minimum** role of state intervention in the economy. The necessity of adopting a limited threshold as low as possible of State intervention in the economy did not result from theoretical analyses or calculations, but from practical experience, not being established or adopted a certain percentage value for the limited threshold of State and public sector participation in the economy.

The intervention of the American State through the federal authorities in economy consists in the development of monetary and budgetary policy strategies. By legislation, a large part of the federal budget is destined for

investments in scientific research and is supported by large private companies and various foundations. The results of the scientific research have been the basis for the development of the most advanced technologies, especially in the fields of informatics, electronic equipment, military and spatial techniques, and in the sciences of life and nutrition (medicine, biology, biochemistry, agricultural sciences etc.) all having essential contributions to the development, at sustained pace, of the American economy and military capacities and spatial techniques of the country. The U.S.A. the State gives a special priority to stimulation (through appropriate legislation) and the development of the private sector, encouraging free enterprise and supporting the establishment of new companies or private companies, including through tax incentives.

Also, in the United States of America, the transnational companies have greatly developed and – in agreement with their definition – have spread almost worldwide and especially in Europe, the best known being, for example, industrial or high-tech companies (Ford, IBM, General Electric, Exxon etc.), food or pharmaceutical (Coca-Cola, Mc Donald's, Colgate) and others.

Due to its resources and the adoption of the Mixed Economy Model, with a **minimum** State intervention threshold, the U.S.A. have maintained sustainable economic growth, as well as a high level of scientific research, especially in scientific research institutes and in private universities (the most performing in the world).

Also, the United States of America has a relatively low unemployment rate compared to other developed States

b) The **German Model** or the “social market economy” in which in addition to the emphasis on promoting companies, private property and the free market characteristic for a market economy, special importance is given to social protection of the population and development of the banking sector, the central bank of Germany having an important role in which the State applies the system of regulating economic activities (in addition to the legislation, whereby the State regulates market rules and rational use of material and human resources). In the case of this model the State has a relatively high share of participation in economics (approx. 30%) with an important routing role, but on the basis of capitalist concepts and ideology [9-11].

The social component of this model is manifested through social assistance to needy persons, unemployed, and families with multiple children, etc. Also, education and healthcare are free [9-11].

c) A variant of the market economy of the Rhine Model is the **Swedish Model** that also applies to the social market economy, placing a great emphasis on social benefits, while watching and reducing the inequalities of wealth between the social classes through income redistribution mechanisms; for this purpose, the State has greatly increased the rate of direct taxes and contributions in order to ensure the necessary amounts of support to the needy or unemployed people, etc. It should be noted that this system didn't have a notable success, as it was inferior to other types of mixed economy, characterized by a smaller role of the State in the economy [9,10].

d) A model of mixed economy between the German and American models is the **French Model**, where the private sector combines with a strong public sector resulting mainly from the nationalization of large enterprises and industries [9]. The State has in this model a much larger role than in the case of the American model (more than 25-30%) having a centralized and planning role in the economy and intervening in social policy through exaggerated stimulation of social benefits, especially during the periods when the left or social democratic parties ruled.

e) The **Japanese Model** of the mixed economy is also characterized through a predominantly role of the market economy, but also by the important presence of the State that is involved in a specific form of economic planning and at the same time strongly supports large Japanese corporations that compete internally but also in great competition with foreign corporations in different fields of activity, especially in the field of automotive industries, electronics, computer technologies, etc. In this respect, the Japanese economy has achieved great success especially after relieving its military spending when, after World War II, Japan was forced, under the conditions of surrender, not to develop an army and a military offensive-type industry, but only forces and equipment for defense and maintaining internal order.

Likewise, Japan's strong economic development is also due to the fact that the level of wages always remains behind the increase of labor productivity, which has led to a decrease in production costs and thus to increasing the competitiveness of Japanese products on international markets [9].

China – which is calling itself as a socialist country – has adopted many of the characteristics of the market economy, leaving the free market and individual private property to operate, including private enterprises at a rate of nearly 60%, but which at the same time being controlled and sometimes helped by the central party and State leadership, in order to generally improve the economy and stimulate social benefits, so in China we are dealing practically

with a mixed economy of special type where the role of the State is quite important, the degree of its implementation in economy can be appreciated at about 40-50% in the presence of a socialist-type ideology. Moreover, in China this economic system is called the “socialist market economy”.

Some countries in **Latin America**, such as **Mexico** or **Colombia** etc., have turned to foreign investors or to the State to create companies with “mixed economy” Joint Venture type, for example, but must be kept in mind that in the case of mixed economy we are dealing with a **organic** merger, nationally – between its own private sector market economy and centralist economy where the State can intervene – but not by command – in a higher or lower degree in directing or supporting the economic development.

From the above it follows that in Mixed Economy, the Free Market and the State intervene in different proportions in regulating the economy, each being placed between the two extremes: **pure market economy** based on market mechanisms in which actors follow their own interests and the State has an extremely limited intervention, and a **centralized or planned economy** based on strong intervention of the public sector and the State in the economic, social and political life of the country.

Currently in most countries the market economy or the centralized economy are not found separated, with the exception of the remaining socialist countries mentioned above, as such current economic systems contain sectors in different proportions of both types of economy so they have the characteristics of a mixed economy in different degrees of State intervention in the economy. As already mentioned, in order to be a stable mixed economy and with a good rate of growth it is essential that the role of the public sector and the State to be as low as possible, preferably under 15-20% or even less. Only in the latter case one can state with certainty that the mixed economy represents the best model for ensuring the sustainable economic development of the most advanced countries with a strong economic development. The most remarkable example of this is the mixed economy from United States of America, which produces about a third of world gross income.

This conclusion results from our proposal for the econophysics model (see Section 4) and from some theoretical considerations, such as those relating to the general equation of economic equilibrium (3) completed by P. W. Samuelson by introducing the term corresponding to public expenditure (including governmental) [3], as well as from the examples found in practice on the harmonious development of economies in the mixed economy countries, with a minimum percentage of the public sector and State intervention in the economy.

In a correct mixed economy the State must not intervene through coercive administrative measures, but only through legislative measures creating the legal framework for the smooth operation and development of private sector agents which produce and participate to the free market, in accordance with the principles and regulations of the market economy. At most, in addition to its function of ensuring legislation specific to a mixed economy, the State itself can develop in the public sector some private companies by which to produce goods or services that private companies or enterprises would not have produced because of the unprofitability of the unique products or technical difficulties of producing them, such as hydro technical dams, public or street lighting, weapons or special equipment factories (spatial, observation and environmental protection) etc.). In the event of such concrete economic problems, the State must behave like any other actor in the market, which produces and trades on the basis of the rules set out by the free market.

4. The advanced model of the mixed economy with maximum threshold (AMMET) as low as possible of the state intervention in economy

4.1. Need to establish a threshold limit of intervention of the State and the public sector in the economy

In the preceding sections it was shown that the economic models that succeeded throughout history were more or less consistent with the development of the real economy from the periods in which they emerged, becoming increasingly evolved and improved.

As a result of the analysis and demonstration brought into the preceding sections, it is apparent that at the present stage of the development of national economies the most adequate economic model appears to be that of the mixed economy adopted also by the laureate of the Nobel Prize for Economy for the year 1970, P. A. Samuelson, which explicitly took into consideration the term G for public (or/and governmental) expenditure, introduced by him in the general equation (3) for the economic equilibrium in the mixed economy.

Section 3 showed that there was a high value diversity of the share of State and public sector participation in the mixed economy in different countries, ranging from values below 25% in more developed countries (USA, England etc.) and approaching the threshold of 50% in countries where a greater role is given to social protection policies or in which there is a control

of the economy from State bodies (such as in France, Japan, China etc.). Hence it follows that for full substantiation of the *Mixed Economy Model* is necessary to determine **the percentage** of the value of an **optimal threshold** of intervention or participation of the State and the public sector in the national economy or which are the percentage limits (lower and upper) that may vary the respective threshold values. This question cannot be answered without a relevant and thorough analysis of the economic conditions and even of the socio-political context of the country concerned, an analysis that can only be made at the historical moment when it is proposed the improvement the economic model for that country.

P. A. Samuelson makes no express mention or warning regarding the level or limit threshold until it can increase the volume of public and governmental expenditure G without causing major imbalances in the normal growth of the economy. On the contrary, P. A. Samuelson gives great freedom to the State saying “*that it can intervene in the economy if necessary*” [4] but further states: “*only in support of private interests and not against them*”. However, Samuelson makes no mention of the value or threshold of GNP (Gross National Product) to which the State and the public sector can intervene in the economy so, in Samuelson’s view, the State could be involved – “*if necessary*” – but in essence, the State would be involved as much as possible, what – in our opinion – is quite dangerous, because basically there is no way to talk about a functional mixed economy, if the intervention of the State and the public sector is major or even closer to 100%, the State having quasi-total control over the national economy.

It is apparent from the foregoing that if we propose to adopt or improve the system of the mixed economy, then the **threshold** or limited **level** to which the State and public sector can intervene in the country’s economy should be specified, otherwise the system can divert to the system of a central-type economy, which is not desirable. This complement that we propose to improve the system of the mixed economy gives the model the characteristics of an “Advanced Model of the Mixed Economy with Threshold – AMMET” – the name that we will continue to use when we refer to the Mixed Economy with a certain minimum threshold of intervention of the public sector and the State in the economy.

However, the following question is asked: How big will the value of this threshold be, and how is it estimated? Considering the analysis and considerations made above, as well as in the previous sections, the value of this threshold must be as **small** as possible, i.e. the free private market

economy to hold a comfortable majority, much higher than the State-controlled part.

4.2. An econophysics approach and model of mixed economy

The econophysics model of mixed economy is based on the model of economic amplifier (Figure 1.a, b), which works by analogy with an electronic amplifier with solid state electronic devices (transistors (Figure 2.a, b) or integrated analog circuits) analyzed in our previous papers [2, 12-15].

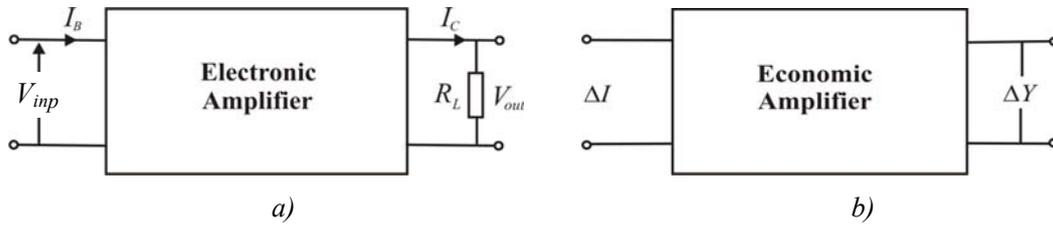


Figure 1. a) Simplified representation of an electronic amplifier with transistors or integrated circuits; b) The representation of economic amplifier.

Amplification factor of the single stage transistor amplifier in Figure 2.a is basically given by the amplifier factor β of the bipolar transistor in common emitter configuration (EC), where emitter's electrode is **common** both for the input and output circuit (Fig. 2. a, b):

$$\beta = \frac{I_C}{I_B} = \frac{I_{out}}{I_{in}}. \quad (4)$$

In equation (4), I_C represents the collector current at the output of the transistor from the amplifier with transistor or integrated circuits, and I_B is the base current that is present in the input circuit (Fig. 2. a, b) [2,12]. In [2, 12] is shown that similarly, an economic amplifier can be characterized by the amplification factor $\beta_{economic}$ given by the equation [2,12-14]:

$$\beta_{ec} = \frac{Y}{I} \quad (5)$$

where Y is the aggregate income obtained on the basis of investments I from "the entry" of economic amplifier (Figure 1.b) [2,12-14].

We can imagine an econophysics model for mixed economy by analogy with the physical structure of a bipolar transistor (Fig. 2.b), which is the active amplification device from an electronic amplifier as the one in Figure 2.a, which as we've shown in our previous paper [2,12-14] perfectly shapes the

economic development phenomenon in a sustainable economy (in which there is growth based on investments I) according to the equation (5) for the economic amplifier [2,12].

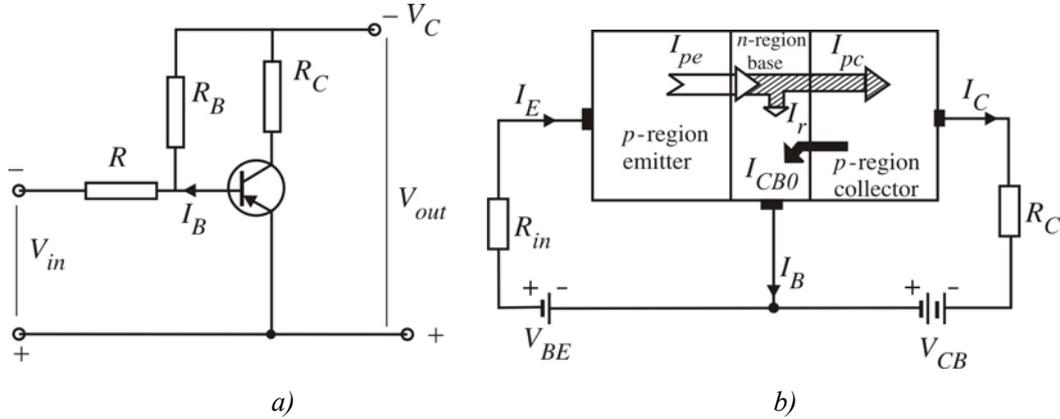


Figure 2.

In the structure shown in Figure 2.b, the p-regions that represent the emitter and, respectively, the collector of the bipolar transistor with p - n junctions, are assimilated to the private sector of the country's market economy, while the n type intermediate region, referred to as the base of the transistor, represents the public sector, its participation and the degree of State intervention in the economy, being characterized by the value I_B of the base current that closes through input circuit of the electronic amplifier (Figure 1 and Figure 2.a) that shapes economic development through the associated economic amplifier (Figure 1.b). In equation (4) it is obvious that excessive increase of current I_B is unacceptable, because it leads to drastic decrease or even cancellation of the amplification factor β , i.e. the economic amplifier doesn't work and economy stagnating. For the proper operation of the amplifier and, respectively, of the mixed economy model, it is essential that I_B to be as low as possible to get a reasonable value for the amplification factor β .

From Electronic and Solid State Physics it is known that the current I_B is given, mainly, by the sum of the reverse current of electrons coming from the collector to the base, I_{CBO} and the current I_r of recombination in the base of positive charge carriers injected from emitter as a result of application of entrance signals and normal bias voltages of the amplification circuit:

$$I_B = I_r + I_{CBO}. \quad (6)$$

In equation (6) we see that for the reduction of the base circuit current I_B is necessary to decrease the width of the base that has the effect of decreasing the level of recombination current I_r the current I_{CBO} having a constant and reduced value.

Decreasing the width of the base is equivalent to a reduction of the public sector and the State influence in economy, according to the econophysics model proposed for mixed economy. Correspondingly decreasing the current I_r , respectively current I_B , together with the width of the base of the transistor structure is equivalent to the significant reduction of public sector and State intervention in the economy. The proposed model has the great advantage that by using it we can also determine the optimum threshold or the maximum limit of the public sector and State intervention in the economy in order to have a performing and sustainable mixed economy.

Indeed, from those shown earlier, it appears that I_B has a much lower value than the main current through the transistor, which is also the output current I_C which allows for an amplified voltage V_{out} from the electronic amplifier (Fig. 2.a). As the value of the current I_B is much smaller than the output current I_C we can write that it represents a fraction α of the value of output current, i.e.:

$$I_B = \alpha I_C \quad (7)$$

with α ranging between 0.1 and 0.9. Replacing (7) in equation (4) and assimilating the output current I_C with the income Y of the economic amplifier results:

$$\beta = \frac{I_C}{I_B} = \frac{I_C}{\alpha I_C} = \frac{1}{\alpha}$$

and respectively:

$$I_B = \alpha I_C = \alpha Y. \quad (8)$$

So transistor's amplification can be increased by decreasing the base width as much as possible (consequently of the public sector and State intervention in the econophysics model) which reduces the base current I_B mainly by reducing recombination current I_r in the base. As a general rule, to compensate for some losses in the elements of an electronic amplifier circuit due to the influence of the environment (temperature, radiation) or bias voltages, in order to achieve the minimum amplification with the single stage amplifier, with one transistor, it is assumed that the current amplification factor β to be at least an order of magnitude larger than the unit, i.e. $\beta = 10$. Using this condition and replacing the value of β in equation (8), results for the fraction α a value of 0.1.

Assimilating the aggregate economic growth Y with the country's Gross Domestic Product (GDP) and replacing $\alpha = 0.1 Y$ in equation (8) results in an optimal percentage value for the degree of intervention in the economy of the State and the public sector given by the current I_B :

$$I_B = 0.1 Y = 0.1 GDP \quad (9)$$

required for optimal operation of mixed economy within the advanced model presented in previous section of the paper.

A complete substantiation and a detailed analysis of the econophysics model for the mixed economy will be developed in a future paper that is in the phase of elaboration and publication.

Taking into account the examples of the developed countries mentioned in section 3 and the considerations made above for the econophysics model of mixed economy, for the significant reduction of public and governmental expenditure, G , it is proposed that the percentage of participation of the public sector and the interference of State in economics to be about 10% of the country's GDP [7]. This percentage can be easily increased depending on the political-economic situation and the development stage of the country concerned.

In favor of adopting a small value (about 10% of GDP) for the public sector and the State intervention threshold in the economy, it also advocates the example of the mixed economy in the United States of America that have a small threshold of state interference in the economy and which, as it has been mentioned, they have the most powerful market economy in the world that produces about one-third of gross world income.

The necessity of adopting a small percentage of the public sector and the State intervention in the economy does not only arise as a result of theoretical analyses and of econophysics model which – for the reduction of public expenditure (the term G of the equation (3) of the economic equilibrium), they recommended a minimum participation of the state in the mixed economy, generally of 10% of GDP – but also from the practical experience of applying the model with a minimum threshold as in the case of countries with strong economic development, the United States of America being the most significant example in this regard.

5. Some considerations regarding the mixed economy in Romania

5.1. The predominant role of the public sector and of the Romanian State in economy generates corruption and leads to an exaggerated increase in public and government spending

In Romania, the market economy began to develop after the Anti-Communist Revolution of the year 1989. Currently the role of the State and public sector in the economy is still very high, government and budgetary

expenditure for the public sector is about 75-80% of the Gross Domestic Product (GDP).

Due to the high share of the public sector and the works contracted with public money, the degree of corruption is very high, being also determined by a poor management carried out by different central bodies (ministries, agencies, departments etc.) or local bodies (from the level of counties and municipalities), the State being generally a poor administrator. Thus, due to corruption and non-performing expenditure of large national companies, there are great losses in their activities that are added to government losses. It is possible to mention, for illustration, losses occurring in construction of highways (for which the execution costs are 5-10 times higher than in other European countries), in the activity of railway transport (CFR) or air transport (the company TAROM), in agriculture, civil or industrial constructions etc. [7]. Also among the activities contaminated by corruption, can be mentioned here the huge losses encountered at the privatization stages of large industry enterprises (steelworkers, petrochemical, refining, the concession of natural gas reserves, etc.) can also be mentioned here the agriculture, scientific and technological research, health, banks and others [7,12].

The emergence of a high volume of public and governmental expenditure (of the Romanian State) is determined by several factors which may be mentioned mainly as follows:

1. The large number of ministries and their branchy structure, agencies, departments or headquarters, and local bodies' structures (municipalities or county structures etc.);
2. The large number of public servants, their lack of efficiency, due to their poor training and their appointment through political protection (political clientele) or relational protection (nepotism);
3. High number of parliamentarians and elected local bodies;
4. Lax laws that facilitate and sometimes even favor the negative consequences of the three aforementioned causes;
5. The outdated and totally disorganized system of state pensions and poorly organized and managed social benefits without any adequately qualified control of those socially assisted by uncontrolled enlargement of voluntary unemployment (of those who no longer want to be employed and live only with social benefits).

All five factors above lead to the emergence of a high degree of corruption that facilitates maintaining of the five previously mentioned negative factors, which ultimately through their synergistic and interdependent action lead to the alarming increase of governmental costs G with negative

consequences on investments I and the standard of living (consumption) of the population.

Indeed, as has been shown earlier, the exaggerated increase in the amount of public and governmental expenditure, represented by the term G of the equation (3) of the economic equilibrium for the mixed economy, will inevitably lead to the weakening of the national economy due to a decrease in the volume of investments I and/or the decrease in consumption C , which adversely affects the living standard of the population [7]. In this situation there cannot be a mixed or sustainable market economy in Romania.

5.2. Some solutions that are required to reduce corruption and exaggerated public spending in Romania

In this section, some recommendations will be made to reduce the role of the State in the economy, implicitly of public spending, in order to reach a system of mixed economy as improved and performing as possible.

For the proper working of the mixed economy's principles in Romania it is recommended to adopt the Advanced Model of the Mixed Economy with a limited threshold (below 10-15%) (AMMET) similar to the neo-American mixed economy model, presented in Section 3, which is the model with the lowest public and government expenditure used in countries that have the world's most efficient economies. In accordance with the econophysics model of the mixed economy, presented in section 4.2., and taking into account the arguments brought in our previous book [7], it is proposed that for the mixed economy in Romania, the threshold for interference of the state in the economy and the State public sector not to exceed 10% of GDP annually.

The most radical measure to reduce government spending could be the drastic reduction of the state's functions going even until its dissolution, but then it would not be a mixed economy. In addition, there are sectors that can be organized, coordinated and controlled only by certain State bodies such as agencies or ministries with a narrower activity such as national defense activities, external representation or cooperation with other nations, preservation of internal order, defense against national disasters and pollution, parliamentary activities and legislation, existence of local organs of order and management of environmental issues, the existence of the National Meteorological Agency etc., the tax agency for general coordination of state revenues and expenditure, etc. In order to drastically reduce the functions of the state and its involvement in the economy, it is necessary to reduce the number of ministries, agencies, departments and organizations of all kinds, as

well as the apparatus of the Presidential Administration, which do not duplicate the activities of parliament or of other agencies or ministries.

As shown in a previous work [7] currently, in Romania there are a large number of ministries (25 in total) some of which seem to be created only to grant functions of ministers or secretaries of State, directors etc. ... for the politicians of the ruling parties (after the 2016 General Elections). Thus, we can meet the names of ministries – which could be simple agencies, departments or directions within other ministries. A sensible merging of such ministries could lead to a number of 10-12 ministries where each could include several departments or agencies coming from the current ministries. Accordingly, the number of deputy prime ministers (now 4) and especially the State Secretaries who now (in 2018) amount to 135 can be reduced – which can be considered to be rather exaggerated. Some considerations and proposals regarding the structure and number of ministries in the Romanian government can be found in the synthesis book [7].

Changes will also be made to Parliament, which will be a unicameral parliament with a much smaller number of parliamentarians (about 100-120); the presidential administration apparatus will also be much reduced without having agencies or services that duplicate some of the duties or activities of Parliament or Government.

With the reduction of the number of ministries and the composition of Parliament and other State agencies and bodies, it will reduce the huge volume of administrative bureaucracy and the huge number of public servants, especially from administration and tax bodies, with the reorganization of the tax system and taxes that will be adequately reduced as a result of reducing the public sector in the economy, supported by budget expenditure.

The reduction of financial losses due to corruption acts can only be achieved by the proper reduction of the public economic sector that is financed with public money from the budget.

Indeed, when it comes to public money no one is in a hurry to save them, because it is not the money of any private entity controllable by General Meeting of Shareholders or the Board of Directors etc. On the other hand, all the tax inspections or checks made by the state are flawed by acts of corruption, so of inefficiency, do not reach their goal and lead to exaggerations, skids or favoritism (protectionism) that severely affect the activity of private firms, subjectively controlled and overwhelmed by fiscal fines.

Consequently, corruption occurs especially where authorities or state bodies spend public money. Private structures and firms are aimed at obtaining profit – in order to survive – and fight more effectively against waste and

corruption if it also occurs in the private sector. That is why for the national economy and for the prosperity of the population it is more advantageous to call on private companies, where they do not work with public money and the level of corruption is approaching virtually zero, of course, if there is no business or onerous partnerships with the State – even if the latter is a minority participant in the structure of the national economy (in the mixed economy with a fixed threshold).

Thus, for the drastic reduction of public and governmental expenditure G , most economic activities at State level will be externalized as far as possible, and in exceptional cases the State may – by appropriate laws adopted by Parliament – to create a minimum network of private companies to take over certain activities that are now being carried out at the level of State organizations or enterprises. Of course, adopting such derogations, the State as a legislative and coordination body together with related companies in the newly created public or state sector must not exceed the maximum threshold (proposed to be 10%) of interference or participation of the State or public sector in the national economy.

It is worth mentioning that in Romania direct appeal to some services, which initially have been made only in the public sector at State level, it is now due to the emergence of many private enterprises or different sectors that already have a significant share in economy, such as transport, sources of electricity, private medical units, education services in schools and private universities, private banks, private security firms and many other such that continue to appear and develop on the basis of the laws of the free market economy. In this respect, notable results have been achieved in very well-equipped private hospitals and clinics, as well as in private education where costs become smaller (compared to state education costs) especially in the units of private higher education where the costs for a student are lower than those of the state, which has made that in several developed countries of the world (U.S.A., Japan, South Korea etc.) to escalate in particular private higher education, which has also led to a much greater economic development for these countries due to scientific discoveries in universities and innovation in management and organization.

As mentioned, the State may also make investments for the production of profit for the purposes of financial support for the specific activities mentioned above, but must do so as any other business company or service for the population or as other companies with which they enter into cooperation on the basis of contracts, with equitable responsibilities of the contracting parties [7].

With regard to other public expenditures, things are not better in other sectors of the State, and we will refer here to the “social pension system and

social aids” given to the “disadvantaged” and to those who receive gratification for certain honorary or merit titles that are so rewarded [7]. We are not against the payment of premiums or certain allowances for those who have done something notable for the country but against erroneous records in which – in these categories – there is a large number of those who have contributed nothing to their worth, very well illustrated by the lists of revolutionaries, participants in the 1989 Revolution, who had contributions and suffered family losses or perished, while others, appearing on lists, had no contribution during the events of December 1989. Similar examples can also be found in other sectors of economic and social life in Romania. For example, the number of those who are retired on sickness or receiving social benefits from unemployment or other aid is also unusually high [7]. In order to reduce losses in this area, it is necessary that through legislative and organizational measures better manage the number of those receiving social benefits or other categories of citizens who – without ever work – receive a guaranteed minimum income, and many of them no longer want to work – although there are jobs available – instead they prefer to live only from social aid. By decreasing this phenomenon of **voluntary unemployment**, public and social expenditure of the State or authorities responsible for administering such aids could be significantly reduced.

Similarly, the pension system will have to be reviewed by insisting on measures which may lead to the limitation of losses in this area. We must mention here that because of the small number of people employed compared to a larger number of pensioners, each year the State “borrows” from the national budget about 12-15 billion lei for the payment of pensions and social aid if not more, the amount ranging from year to year depending on the total number of pensioners.

In order to remedy the situation of social pensions, it is recommended to significantly limit the number of early or the case of sickness retirements and to move quickly to **two-speed retirement** and to the gradual increase in the retirement age although this last measure is somewhat unpopular [7]. Every citizen must choose between working for several more years and receiving a pension, or not working above the current age limit and receiving nothing or receiving a very small pension – because there will be no money to pay all the pensions. It is also necessary to encourage and support the poorly developed private pension system [7].

The two-speed retirement means retirement at the normal retirement age – for those with the standard (compulsory) contribution period (first speed), and retirement, **on request, after the normal retirement age** (second retirement speed, slower) for those who want – and there are many who want –

to remain in activity more years and then receive a higher pension due to the greater number of years of contribution to the pensions and social insurance budget. In this category can enter artists, magistrates, physicians, teachers of all degrees as well as many categories of managers and officials etc. [7]. Data on such a two-speed retirement system can be found in the work [12], p. 204.

It is obvious that, if we want to improve and optimize the mixed economy in Romania, solutions and concrete ways to solve problems related to the creation and organization of new economic and social structures will be proposed and solved by working groups, consisting of experts from different areas of activity, and now in the current system of ministries and agencies with which they will work together in a first step. Afterwards, they can move to the next phases until the stage in which the public sector and the state intervene in the economy with a small budget and involvement of up to 10% of GDP [7].

6. Conclusions

Currently the mixed economy is the most important and recommended economic system, being present in almost all of the countries of the world where the market economy operates.

In this paper an econophysics model based on the analogy between mixed economy principles and operating principles of semiconductor amplifying devices (transistors or integrated circuits) from Solid-State Physics and Electronics is proposed and analyzed.

The success and performances of the use of the mixed economy depends on the size of the public sector (controlled and developed by the state) and the degree of state involvement in the economy.

For a harmonious development of the national economy it is necessary that the size of the public sector and the degree of state involvement in the economy to be as low as possible. In this paper, on the basis of the econophysics model of the mixed economy is proposed a value of about 10% of GDP for the maximum threshold of public and governmental expenditure and the involvement of the State in the economy, which must be as low as possible.

The degree of state interference in the economy and social-economic activities is determined by public and government spending, as well as the number of ministries, agencies and governmental organizations that need to be optimized and reduced for the drastic limitation of public and government expenditure.

The paper shows that, as a rule, the high share of the public (State) economic sector and public and governmental expenditure also determines a

high degree of public sector corruption due to, in particular, to the methodology and ways of interaction between public and private sectors through the management of economic contracts and deficient or politically influenced tax and economic legislation.

In order to reduce public and governmental expenditure in Romania, it is necessary to optimize and decrease the number of public servants, parliamentarians – organized in a unicameral parliament, – as well as local bodies in municipalities and counties.

Also, in order to reduce public and government spending, it is necessary to reform and improve the social aid system and social pension system through measures that eradicate voluntary unemployment, respectively by raising of the retirement age and the adoption of two-speed retirement, in order to improve the ratio between the number of employees and the number of pensioners, which is currently less than one (subunitary).

REFERENCES

1. I. Vasilescu, I. Românu, C. Cicea, *Investments* (in Romanian), Bucharest, Economică Tribune Publishing, 2000;
2. Anca Gheorghiu, *Econophysics of Investments* (in Romanian), Bucharest, Victor Publishing, 2007;
3. J. M. Keynes, *General Theory of Employment, Interest and Money*, 1936; New Delhi, Atlantic, 2008;
4. P. A. Samuelson, W. D. Nordhaus, *Economics*, New York, The Mc Grow-Hill, 16th Edition, 2007;
5. V. Crăciuneanu, *Theories and Economic Doctrines* (in Romanian), Bucharest, University Publishing, 2013;
6. Michel Albert, *Capitalism Against Capitalism*, New York, 1993, ISBN: 978-1-870-33 254-5;
7. I. Spânulescu, *Mixed Economy* (in Romanian), București, Editura Victor, 2017;
8. Stephen C. R. Munday, *Current Developments in Economics*, Palgrave, Macmillan, 1996;
9. I. Roman, *Mixed economy and its contemporary models*, in www.academia.edu/180473/Economia_mixta_si_modelele_ei_contempo-rane, visited at 14.09.2017;
10. <https://documents.tips>Documents, EconomiaMixta-Documents, Wikipedia, visited at 14.09.2017;>
11. [https://documents/economia-mixta-55a4d097d78c8.html;](https://documents/economia-mixta-55a4d097d78c8.html)
12. I. Spânulescu, *Journey through life and time* (in Romanian), Bucharest, Victor Publishing, 2011, p. 304.

